Clean Coalition

Making Clean Local Energy Accessible Now

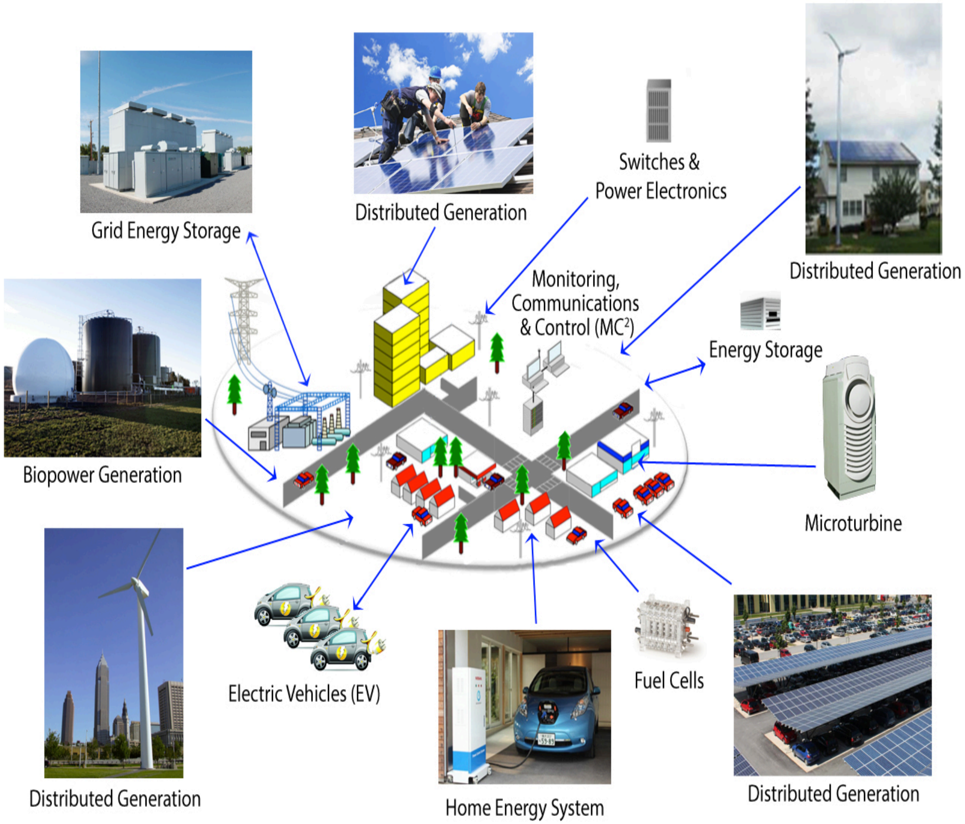
Community Microgrid Initiative

Update for DRP Tech Workshop, Jan 8 2014

Greg Thomson
Director of Programs
Clean Coalition
415-845-3872 mobile
greg@clean-coalition.org

Community Microgrid Initiative

The Clean Coalition's Community Microgrid Initiative accelerates and scales DRPs, DER optimization, local renewables, and a modern grid in two ways:



1. **<u>Design</u>**: replicable planning methodology based on existing tools:
   - Cyme, validated w/PG&E, vendors, CPUC (e.g. for AB-327 DRP)
   - Cost optimization via Integral Analytics

2. **<u>Deployment</u>**: Procurement & Interconnection at scale based on Local Capacity Targets
   - Procurement: wholesale/FIT for key customer segments
   - Interconnection: "Plug-n-Play" deployment at scale

Result: Distributed Energy Resources can deploy at scale in months rather than years.
A massive acceleration of "one rooftop at a time…"

DRP & DER Optimization: Local Is Fundamental

Clean Coalition

Taken together, local grid characteristics unlock optimal and cost-effective DER portfolios. Used optimally, the distribution grid becomes an asset.

More reliable, predictable costs, cleaner, etc.

Local Market Value – e.g. Rates

Local feeder capacity

In combination with the other characteristics

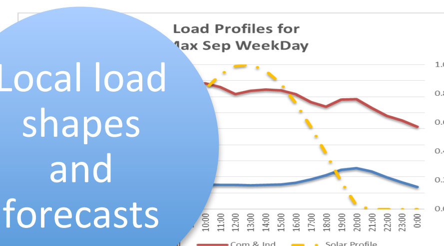
Locally connected feeders

Helps with local balance

Optimal DER Portfolio

Also extends to system-wide avoided costs

Local avoided grid upgrades



Local load shapes and forecasts

Differentiated customers, specific to location

DER Optimization Methodology

Clean Coalition

Inputs

Data, Utilities:
- Loads, load forecasting
- Network model & circuit map
- Equipment list, upgrade plan, O&M schedule
- Transmission constraints

Data, Other:
- Solar insolation
- Weather forecasting
- DG analysis
- DER specs: storage, DR, etc.

4. Higher Capacity & Cost

- **Higher DG level that islands critical services via additional storage and/or local reserves (e.g. CHP)**
- **Optimize via locations, sizes, types, costs, system deferrals**

3. Medium Capacity & Cost

- **Target DG level and/or net grid value that adds cost-effective storage, DR, and may require some grid upgrades**
- **Optimize via locations, sizes, types, costs, system deferrals**

2. Lower Capacity & Cost

- **Initial DG level using existing voltage regulation (e.g. LTCs) w/ advanced inverters while requiring minimal grid upgrades**
- **Optimize via locations, sizes, types, costs, system deferrals**

1. Baseline Powerflow

- **Acquire all data sets, validate data accuracy**
- **Model existing grid area, including existing DG**

Outputs

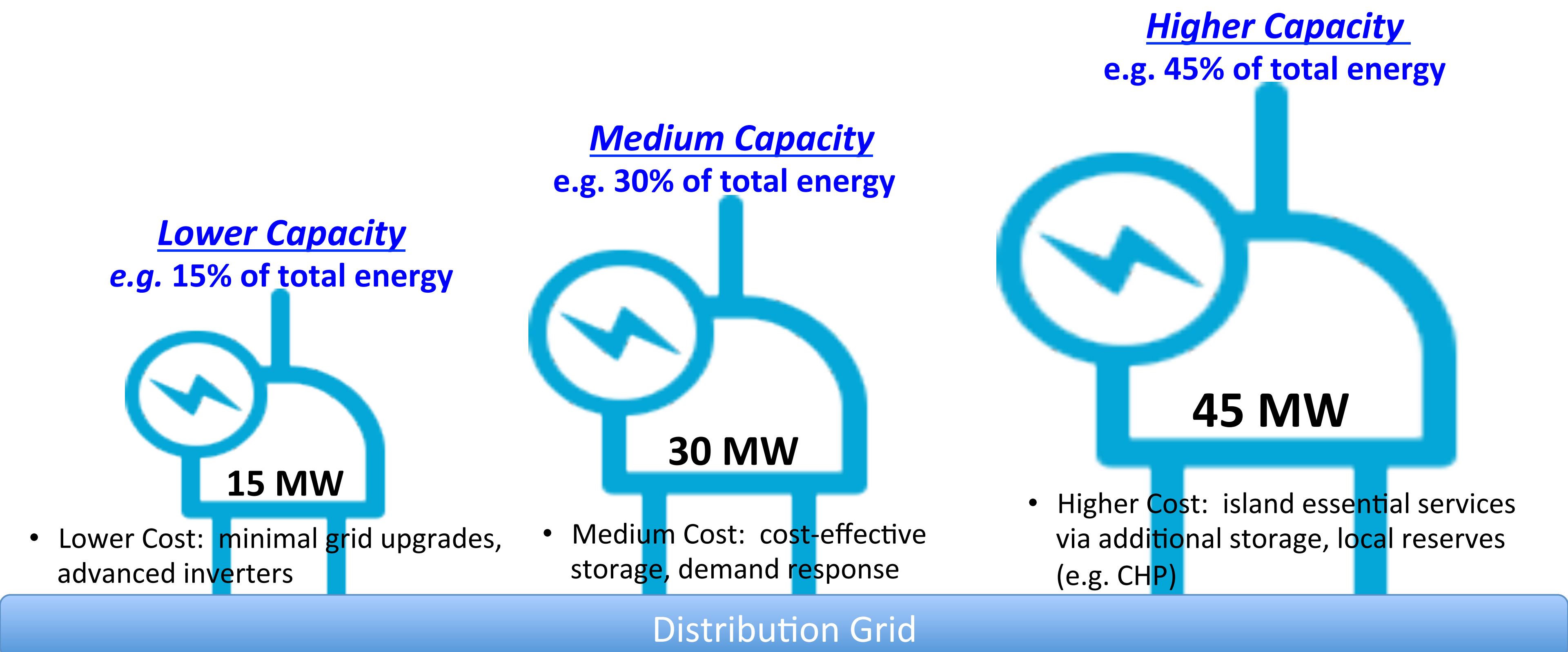
- Scalable and optimized plan both operationally and financially
- Results validated with utility & tech vendors
- Grid reliability & power quality maintained or improved

Local Capacity Targets Achieve Scale, Lower Costs

Clean Coalition

- **Today's "one-rooftop-at-a-time" approach is both costly and disruptive to the grid**
  - **Local Capacity Targets achieve scale, lower costs, and operational stability**
- **This "Plug-n-Play" method also enables apples-to-apples cost comparisons with centralized generation, which is already at scale**

Examples of Local Capacity Targets

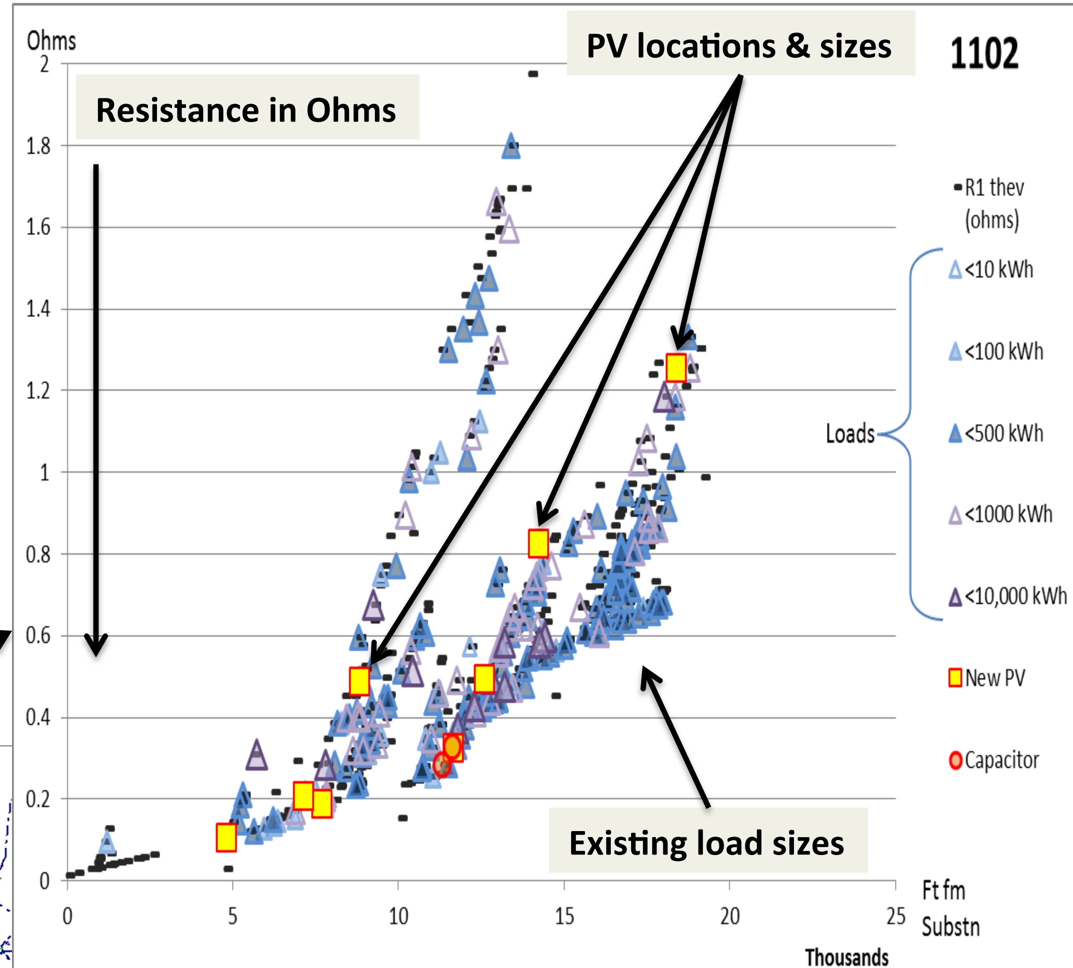


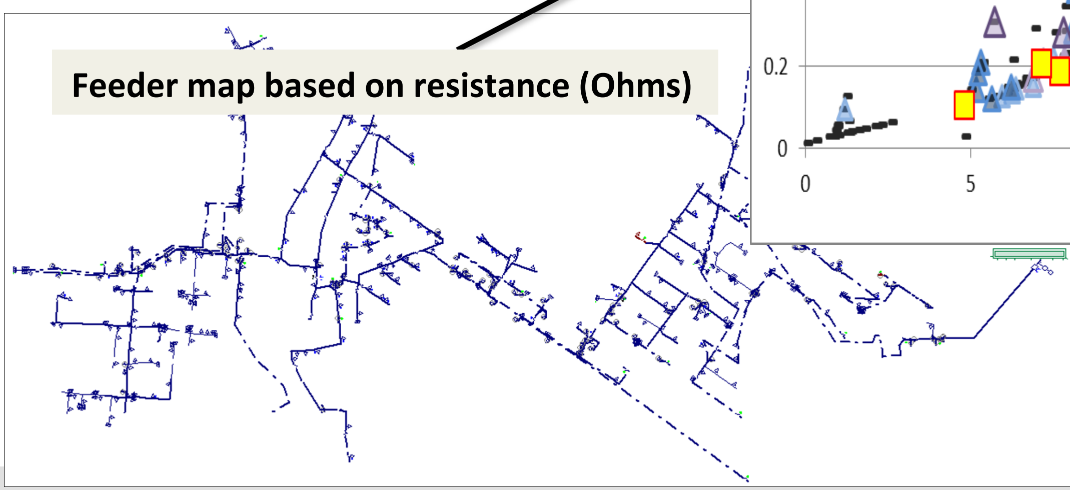
Optimal Locations are Key to Unlocking DER

Clean Coalition

For example, identifying PV optimal locations via:

1. <u>Robust feeder locations</u>: less resistance (lower Ohms) means more capacity for local generation
2. <u>Matching load types</u>: e.g. higher loads during daytime means better match for PV
3. <u>Avoided costs</u>: service transformers, etc.

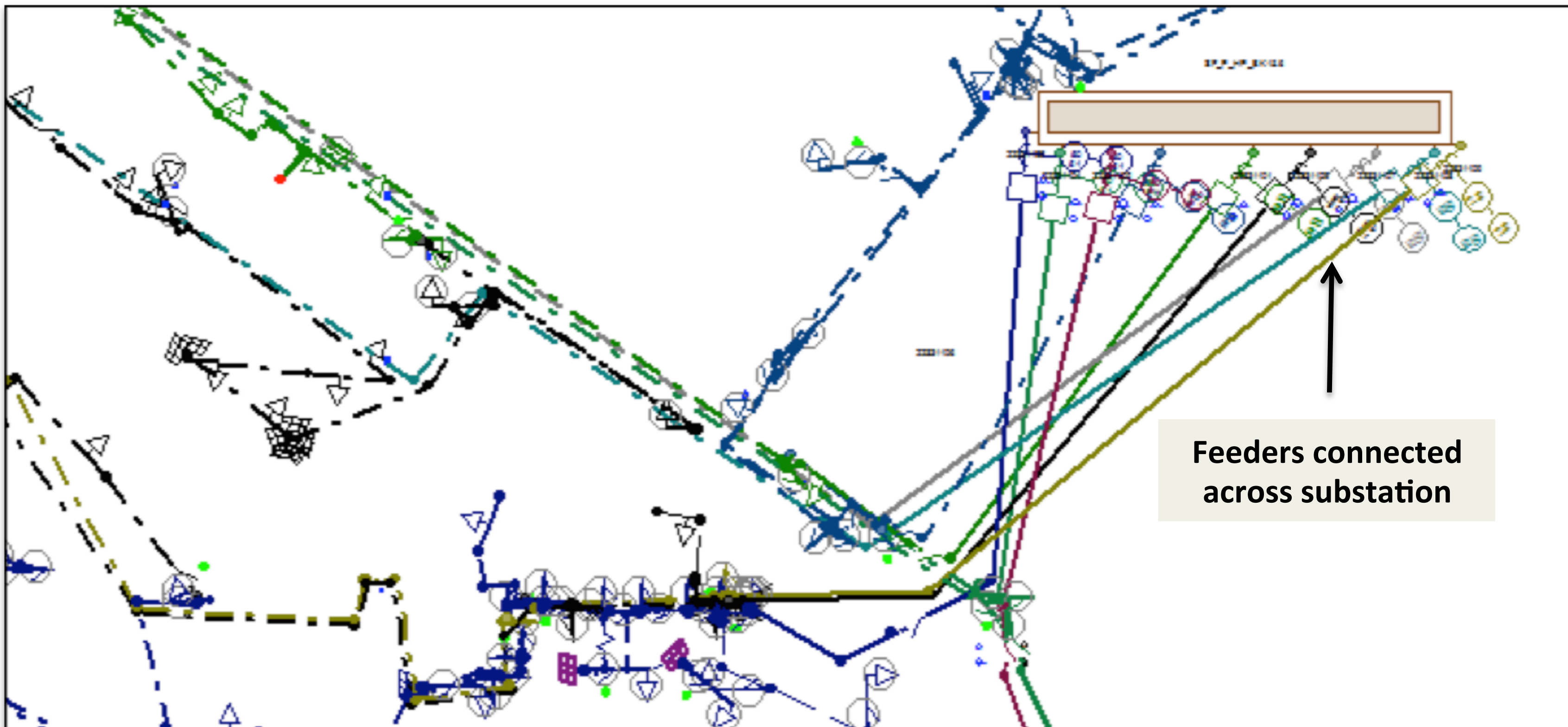




Additional Optimization: "Substation-as-a-System"

Connected feeders enables substation-wide optimizations, such as:

1. "Crossfeeding," e.g. over-generation on certain feeders consumed by load on other feeders in the substation area
2. Optimizing DER such as storage and demand response across the substation feeders
3. Optimizing settings, e.g. load tap changers, across the substation feeders



Results to Date: Lower Capacity & Cost Scenario

Clean Coalition

In Hunters Point substation area:

- **30 MW of new PV added to the substation feeders at optimal locations, equaling 25% of total annual energy**
  - 20 MW added to select Commercial & Industrial sites matching low resistance locations with higher daytime loads
  - 10 MW added to select Residential sites (multiple dwelling units) matching more robust feeder locations
- **No adverse impacts to distribution grid operations**
  - No Out-of-Range voltages. Voltage regulation achieved using existing Load Tap Changers (advanced inverters not needed yet).
  - No Backfeeding to Transmission. Some "Crossfeeding" between feeders.

Results, Lower Capacity: Voltages & Major Power Flows, Weekdays (no PV vs. PV)

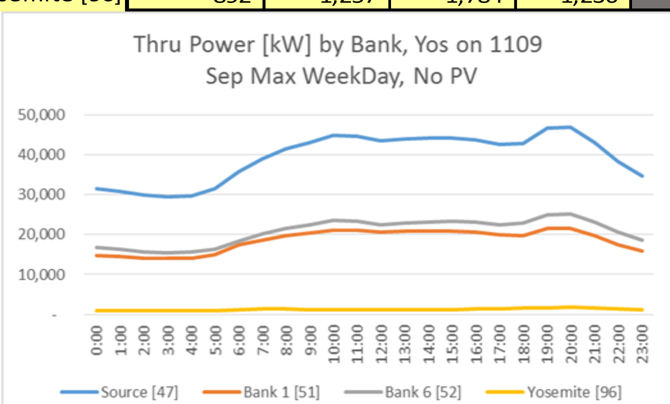
Clean Coalition

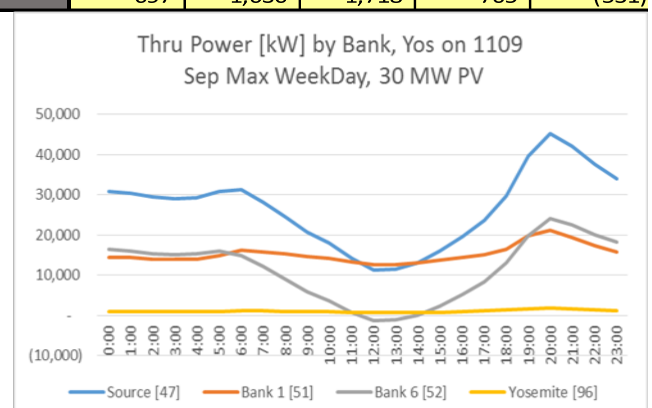
		PV: None			PV: 20 C&I + 10 Res		
		Sep WkDay Max Load Profiles			Sep WkDay Max Load Profiles		
Voltage Summary		Min	Avg	Max	Min	Avg	Max
		V_Base, all monitored pts			V_Base, all monitored pts		
22331106	Bank 1 [51]	121.6	122.9	124.6	121.5	122.9	124.0
22331105	Bank 1 [51]	121.7	122.9	124.6	121.6	122.9	124.0
22331104	Bank 1 [51]	122.2	123.8	125.4	122.1	123.7	124.7
22331103	Bank 1 [51]	119.7	122.6	124.6	119.4	122.5	123.9
22331101	Bank 6 [52]	122.0	122.9	123.9	121.2	122.8	123.8
22331102	Bank 6 [52]	118.8	120.7	123.6	118.3	121.0	123.6
22331107	Bank 6 [52]	116.5	119.2	123.5	115.8	119.4	123.5
22331108	Bank 6 [52]	118.0	119.7	123.6	117.2	119.9	123.5
22331109	Bank 6 [52]	118.9	121.2	123.7	118.0	121.2	123.6
22490401	Yos [96]	118.9	121.7	124.5	117.4	122.0	125.1
22490402	Yos [96]	122.3	123.6	124.7	118.9	123.1	125.2

Voltages in Range

Bus Rpt	kW Thru Pwr					kW Thru Pwr				
	Min	Avg	Max	Noon	NoonDif	Min	Avg	Max	Noon	NoonDif
Source [47]	29,440	39,393	46,921	43,417		11,263	26,673	45,309	11,263	(32,154)
Bank 1 [51]	14,003	18,507	21,552	20,725		12,585	15,272	21,099	12,585	(8,140)
Bank 6 [52]	15,352	20,748	25,184	22,529		(1,376)	11,310	24,036	(1,376)	(23,905)
Yosemite [96]	892	1,257	1,784	1,236		697	1,030	1,718	705	(531)

Feeder "Crossfeeding," no Backfeeding to Transmission





Results, Lower Capacity: Voltages & Major Power Flows, Weekends (no PV vs. PV)

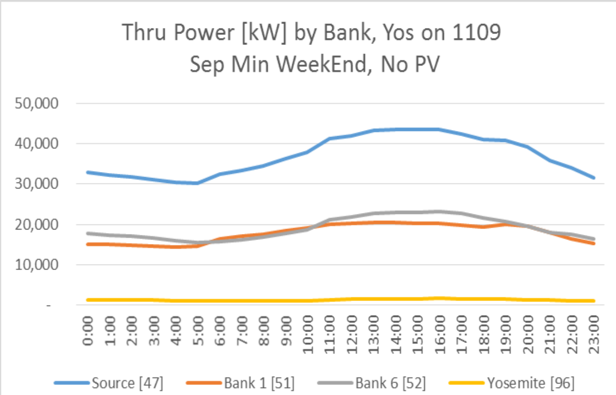
Clean Coalition

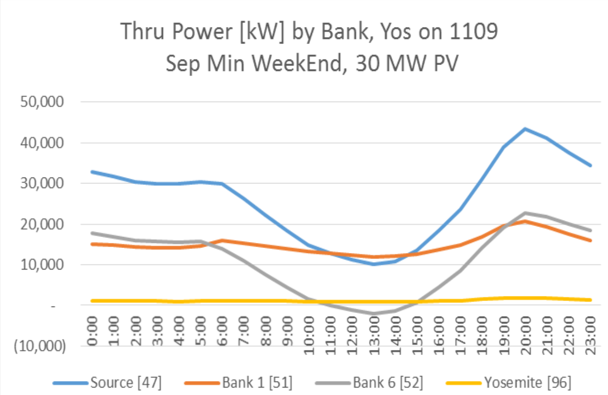
Voltage Summary		PV: None — Sep WkEnd Min Load Profiles, no PV — V_Base, all monitored pts: Min	Avg	Max	PV: 20 C&I + 10 Res — Sep WkEnd Min Load Profiles — V_Base, all monitored pts: Min	Avg	Max
22331106	Bank 1 [51]	121.8	122.9	124.0	121.5	123.0	124.0
22331105	Bank 1 [51]	122.0	122.9	124.0	121.7	123.0	123.9
22331104	Bank 1 [51]	122.3	123.8	124.8	122.1	123.8	124.7
22331103	Bank 1 [51]	120.0	122.6	124.0	119.4	122.5	123.9
22331101	Bank 6 [52]	122.1	122.8	123.3	121.4	122.8	123.9
22331102	Bank 6 [52]	118.9	120.6	123.2	118.3	121.0	123.6
22331107	Bank 6 [52]	116.7	119.1	123.1	115.9	119.4	123.5
22331108	Bank 6 [52]	118.1	119.7	123.1	116.9	119.7	123.5
22331109	Bank 6 [52]	119.1	121.0	123.2	118.2	121.3	123.6
22490401	Yos [96]	119.5	121.9	124.7	117.7	122.1	125.2
22490402	Yos [96]	122.7	123.7	124.8	119.2	123.1	125.3

Voltages in Range

Bus Rpt	kW Thru Pwr (PV: None) Min	Avg	Max	Noon	NoonDif	kW Thru Pwr (PV) Min	Avg	Max	Noon	NoonDif
Source [47]	30,132	36,890	43,613	42,023		10,040	26,029	43,540	11,200	(30,823)
Bank 1 [51]	14,322	17,746	20,440	20,124		11,982	15,015	20,705	12,345	(7,779)
Bank 6 [52]	15,444	19,020	23,232	21,748		(1,992)	10,926	22,669	(1,198)	(22,946)
Yosemite [96]	959	1,217	1,565	1,346		808	1,184	1,838	952	(394)

Feeder "Crossfeeding," no Backfeeding to Transmission





End